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ABSTRACT

This vocational program guide is intended to assist in the organization, operation, and evaluation of a program in electromechanical technology in school districts, area vocational centers, and community colleges. The following topics are covered: job duties of electromechanical technicians; program content (curriculum framework and student performance standards); program implementation (student admission criteria, cooperative education, and student organization participation); instructional resources; facilities (facility design recommendations and safety, maintenance, and liability); suggested equipment; and professional development (technical updating and teacher standards and related professional organizations and support services). A Career Merit Achievement Plan (Career MAP) for use in recording the progress of students enrolled in an electromechanical technology program is packaged with the program guide. Included in the Career MAP are a list of relevant job titles, overview of the MAP and directions for using it, guidelines for rating student performance standards, and charts detailing the various subcompetencies of the electromechanical technology skills and work environment readiness skills covered in the electromechanical technology program. (MN)

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FLORIDA VOCATIONAL PROGRAM GUIDE FOR ELECTROMECHANICAL TECHNOLOGY

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INTRODUCTION

Vocational education meets the needs of students desiring to pursue a selected vocation and is designed to provide training that is realistic in meeting present and future employment opportunities. In recent years, applications of science and technology have expanded rapidly, increasing the education and training required of workers. This has made vocational training programs more attractive as an educational option. The new technologies require well-trained workers to carry out both standardized and specialized procedures, and whose training foundations have given them the capacity to keep pace with continuing technology demands.

The Florida Department of Education shares with business and industry the determination to provide opportunities for upward mobility to as many Floridians as possible. Vocational training programs can keep pace with the demands of new industrial patterns and can provide the opportunity for many of our citizens to gain financial stability and an improved sense of self worth. Therefore, it is necessary to create exemplary vocational programs and to make those programs consistent throughout the state.

This Program Guide identifies primary concerns that should be considered in the organization, operation and evaluation of a vocational education program. It has been developed to provide useful information to local school district and community college administrators, instructors, program advisory committees, regional coordinating councils and others charged with the responsibility of offering vocational education programs.

OCCUPATIONAL DESCRIPTION

A principle occupational title is identified for each vocational training program. This title is validated by the United States Department of Labor Dictionary of Occupational Titles (DOT) or other appropriate references. Such references may be the United States Department of Commerce Standard Occupational Classification Manual (SOC), the Occupational Employment Statistics Survey Dictionary (OES), or Vocational Preparation and Occupations (VPO) prepared by the National and State Occupational Information Coordinating Committees. Information obtained from industry advisory committees may also be used to validate the principle occupational title. The job title and code number for this program are listed in the curriculum framework which accompanies this guide.

The United States Department of Labor Dictionary of Occupational Titles (D.O.T.) identifies the job title for this occupational area as follows:

D.O.T. JOB TITLE	D.O.T. CODE
Electromechanical Technician	710.281-018

The definition (description) for this job title is taken from the D.O.T. for easy reference.

ELECTROMECHANICAL TECHNICIAN

Fabricates, tests, analyzes, and adjusts precision electromechanical instruments, such as temperature probes, gyroscope units, telemetering systems, altimeters and aerodynamic probes, following blueprints and sketches, using handtools, metalworking machines and measuring and testing instruments: Operates metalworking machines, such as bench lathe, milling machine, punch press and drill press, to fabricate housings, fittings, jigs and fixtures and verifies dimensions, using micrometer and calipers. Assembles wires, insulation, and electrical components, such as resistors and capacitors, following method layouts, using fixtures, binocular microscope, soldering tools, tweezers and handtools. Installs electrical assemblies and hardware in housing, using handtools and soldering equipment. Tests assembled instruments for circuit continuity and operational reliability, using multimeter, oscilloscope, oscillator, vacuum tube voltmeter and bridge. Analyzes test results and repairs or adjusts instruments according to analysis. Records test results and writes report on fabrication techniques used. May calibrate instrument dials according to established standards. May

specialize in assembly of prototype instruments and be designated as DEVELOPMENT TECHNICIAN (inst. & app.), or in assembly of production instruments and be designated as FABRICATION TECHNICIAN (inst. & app.).

PROGRAM CONTENT

The Division of Vocational, Adult, and Community Education, as required by State Board of Education **(S.B.E.) Rule 6A-6.0571**, publishes Vocational Education Program Courses Standards annually. This document specifies the minimum program content for the operation of a vocational training program for the occupational titles listed. Each program identified in the Florida Department of Education Course Code Directory is required to establish course standards. The standards for each vocational offering are comprised of two major components: (1) Curriculum Framework and (2) Student Performance Standards.

Curriculum Framework (CF)

The Curriculum Framework specifies the exact course title, course number, levels of instruction, major course content, laboratory activities, special notes, major course concepts and intended outcomes. The program requirements stipulated in the curriculum framework have been approved by the State Board of Education and are the legal bases for delivery of instruction.

Student Performance Standards (SPS)

The Student Performance Standards are a resource list of job-specific competencies. This list is generated and approved by industry experts and becomes the basis for curriculum development in vocational programs. Local school districts and community colleges must, by law, adopt student performance standards for their vocational programs. They may, at their discretion, adopt the list provided or develop their own as long as there is sufficient content to address each intended outcome. A program may provide instruction beyond the minimum specified in the SPS if desired. The decision to do this should be based on local industry needs. However, the minimum must be presented.

The SPS for secondary level programs contain a third component, course structure. This component specifies the number of courses required for program completion and the content of each course. The courses may be taught in any sequence, but the content may not be changed unless approved by the Division of Vocational, Adult, and Community Education.

The curriculum framework and student performance standards are intended for use as a guide, not a teaching tool. Teachers or curriculum development personnel are expected to develop or select complete curriculum materials for their training programs based on the curriculum framework and student performance standards. Each intended outcome and SPS should be thoroughly analyzed for related cognitive and procedural subskills. The curriculum framework and student performance standards are presented in the following pages.

CURRICULUM FRAMEWORK PROGRAM AREA: Industrial

FLORIDA DEPARTMENT OF EDUCATION EFFECTIVE DATE: July, 1991

PROGRAM TITLE: Electromechanical Technology

CODE NUMBER: Secondary _____ Postsecondary EEV0440

Florida CIP 0615.040300

SECONDARY SCHOOL CREDITS ___ COLLEGE CREDITS ____ POSTSECONDARY ADULT VOCATIONAL CREDITS X

APPLICABLE LEVELS(S): ___ 7-9 ___ 9-12 ___ Postsecondary Adult Vocational

___ Postsecondary Vocational X Other 30-31

CERTIFICATION COVERAGE: TEC MECH @ 7 TEC ELEC @ 7 ELECTRONIC 7

I. MAJOR CONCEPTS/CONTENT: The purpose of this program is to prepare students for employment as electronic precision assemblers (93114859), electromechanical technicians (710.281-018). This program also provides supplemental training for persons previously or currently employed in this occupation.

The course content includes, but is not limited to, operation, maintenance and repair of electrical motors and control panels, hydraulic systems, pneumatic systems, laser electro-optic systems, mechanical drives and conveyor systems, computers, communications equipment and robotic systems.

The course content should also include training in communication, leadership, human relations, employability skills, and safe, efficient work practices.

II. LABORATORY ACTIVITIES: Shop or laboratory activities are an integral part of this program. These activities provide instruction in the use of tools, equipment, materials and processes found in the industry. Students will use various types of precision test equipment for analyzing, troubleshooting and repairing electromechanical equipment.

III. SPECIAL NOTE: The Vocational Industrial Clubs of America, Inc. is the vocational student organization which reinforces classroom instruction by providing communications, leadership, human relations and employability training experiences. It also reinforces specific vocational skills. When provided, these activities are considered an integral part of this program.

The cooperative method of instruction may be utilized for this program. When the cooperative method is offered, the following is required for each student: a training plan signed by the student, teacher and employer which includes instructional objectives and a list of on-the-job and in-school learning experiences; and a work station which reflects equipment, skills and tasks relevant to the occupation the

student has chosen as a career goal. The student must receive compensation for work performed.

Electronic Technology and/or Electronic Engineering Technology are prerequisites for entry into this electronic specialization. Algebra is recommended as a prerequisite for entry into this program.

In accordance with Section 233.0695 F.S., the minimum basic skills grade level required for this postsecondary adult vocational program is: Mathematics 10.0, Language 9.0. This grade level number corresponds to a grade equivalent score obtained on a state designated basic skills examination.

To be transferable statewide between institutions, this program/course must have been reviewed, and a "transfer value" assigned the curriculum content by the appropriate Statewide Course Numbering System discipline committee. This does not preclude institutions from developing specific program or course articulation agreements with each other.

This program may be offered in courses. Vocational credit shall be awarded to the student on a transcript in accordance with Section 230.643. F.S.

The typical length of this program for the average achieving student is 960 hours.

IV. INTENDED OUTCOMES: After successfully completing this program, the student will be able to:

01. Demonstrate proficiency in electronic and mechanical blueprint reading.
02. Demonstrate proficiency in electronic communications circuits.
03. Demonstrate proficiency in advanced microprocessors.
04. Demonstrate proficiency in computer software applications.
05. Demonstrate proficiency in motors and motor control circuits.
06. Demonstrate proficiency in laser electro-optics.
07. Demonstrate proficiency in hydraulic and pneumatic systems.
08. Demonstrate proficiency in mechanical power transmission systems.
09. Demonstrate proficiency in mechanisms, linkages and levers.
10. Demonstrate proficiency in transducers and instrumentation.
11. Demonstrate proficiency in video systems.
12. Demonstrate proficiency in statics and industrial materials.
13. Demonstrate proficiency in automatic controls and robotics.

STUDENT PERFORMANCE STANDARDS EFFECTIVE DATE: July, 1991

PROGRAM AREA: Industrial SECONDARY NUMBER:

PROGRAM TITLE: Electromechanical Technology POSTSECONDARY NUMBER: EEV0440

01.0 DEMONSTRATE PROFICIENCY IN ELECTRONIC AND MECHANICAL BLUEPRINT READING--The student will be able to:

- 01.01 Describe types of blueprints and their applications.
- 01.02 Read drawings and transfer measurements.
- 01.03 Identify, use and understand application of auxiliary views, revolutions, sectional views and orthographic projections.
- 01.04 Apply dimensioning practices and techniques to drawings.
- 01.05 Apply x-y coordinate dimensioning.
- 01.06 Apply geometric dimensioning and tolerancing procedures
- 01.07 Identify symbols used to represent materials and standard fits.
- 01.08 Interpret mechanical production blueprints and assembly drawings.
- 01.09 Trace a circuit through a multilayer board.

02.0 DEMONSTRATE PROFICIENCY IN ELECTRONIC COMMUNICATIONS CIRCUITS--The student will be able to:

- 02.01 Construct and analyze Amplitude Modulated (AM) circuits.
- 02.02 Construct and analyze Frequency Modulated (FM) circuits.
- 02.03 Define radio propagation, antennas and transmission lines.
- 02.04 Construct and analyze microwave systems.

03.0 DEMONSTRATE PROFICIENCY IN ADVANCED MICROPROCESSORS--The student will be able to:

- 03.01 Identify the characteristics and functions of advanced microprocessor chips.
- 03.02 Program advanced microprocessors using machine languages.
- 03.03 Perform diagnostic troubleshooting on advanced microprocessor systems.
- 03.04 Describe the operation and applications of synchronous and asynchronous devices, interface adapters and timer modules.
- 03.05 Analyze the basic architecture of a typical microcomputer system, and describe the types of input and output storage methods used.
- 03.06 Utilize binary and hexidecimal numbering systems.
- 03.07 Analyze and program CPU's using subroutines and interrupts.
- 03.08 Interface advanced peripheral devices.
- 03.09 Describe the operation of data communications systems.
- 03.10 Identify the components of data communications systems.
- 03.11 Analyze and define data communication codes, formats and protocols.
- 03.12 Identify serial and parallel ports and explain their use.
- 03.13 Set up and operate modems.
- 03.14 Analyze and troubleshoot modems.
- 03.15 Identify and describe types of carrier systems.
- 03.16 Interconnect systems using the RS-232, RS-422 and IEEE488 interface standards.
- 03.17 Analyze and troubleshoot base band and broad band local area networks.

04.0 DEMONSTRATE PROFICIENCY IN COMPUTER SOFTWARE APPLICATIONS--The student will be able to:

- 04.01 Identify types of industrial software languages such as Assembly and machine code.
- 04.02 Load and run various types of software programs in a computer.
- 04.03 Utilize diagnostic software to troubleshoot malfunctions.
- 04.04 Identify and utilize various software packages.
- 04.05 Execute applicable software packages.

05.0 DEMONSTRATE PROFICIENCY IN MOTORS AND MOTOR CONTROL CIRCUITS--The student will be able to:

- 05.01 Identify and locate reference documents for the National Electric Code and other electrical standards.
- 05.02 Identify types of relays and describe their operation and applications.
- 05.03 Identify types of electric motors and describe their operation and applications of their protection circuits.
- 05.04 Identify types of transformers and describe their operation and applications.
- 05.05 Identify types of motor controllers and describe their operation and applications.
- 05.06 Interpret relay ladder logic diagrams.
- 05.07 Construct manual motor starting and reversing circuits.
- 05.08 Construct magnetic motor starting and reversing circuits.
- 05.09 Construct and troubleshoot relay logic circuits.
- 05.10 Identify the basic elements of solid state motor control.
- 05.11 Analyze and troubleshoot three phase motor control circuits.
- 05.12 Analyze and troubleshoot synchronous motor controls.
- 05.13 Analyze and troubleshoot basic servo systems.
- 05.14 Analyze and troubleshoot variable frequency drives.
- 05.15 Analyze and troubleshoot brushless DC motor controls.
- 05.16 Construct and troubleshoot timing control circuits.
- 05.17 Identify power distribution systems.
- 05.18 Analyze and construct photoelectric and proximity sensor circuits.

06.0 DEMONSTRATE PROFICIENCY IN LASER ELECTRO-OPTICS--The student will be able to:

- 06.01 Identify safety hazards and regulations of laser applications.
- 06.02 Define, calculate and measure the properties of laser light.
- 06.03 Define the elements of a basic lasing system.
- 06.04 Identify and define types and classes of lasers.
- 06.05 Define the fundamental laws of optics.
- 06.06 Identify and define the function of laser accessories.
- 06.07 Analyze and define common laser applications.
- 06.08 Analyze and measure laser outputs.
- 06.09 Align and adjust laser systems for specific outputs.
- 06.10 Define the use of electro-optic modulators and mechanical beam deflectors.
- 06.11 Measure the characteristics of electro-optic semi-conductors.
- 06.12 Identify electro-optic principles.
- 06.13 Construct circuits for electro-optic light sources.
- 06.14 Construct and troubleshoot electro-optic display circuits.
- 06.15 Construct circuits for light reactive devices.
- 06.16 Measure light transmission through fiber optic devices.

06.0 DEMONSTRATE PROFICIENCY IN HYDRAULIC AND PNEUMATIC SYSTEMS--The student will be able to:

- 07.01 Identify the components of hydraulic systems and describe their functions.
- 07.02 Construct and troubleshoot basic hydraulic circuits.
- 07.03 Identify hydraulic symbols, components and types of fluids.
- 07.04 Construct and troubleshoot hydraulic circuits using flow control valves, pressure valves and sequence valves.
- 07.05 Construct and troubleshoot hydraulic circuits using directional and slow control valves.
- 07.06 Analyze, construct and troubleshoot hydraulic circuits that utilize actuator speed control and counter balance devices.
- 07.07 Construct and troubleshoot hydraulic circuits using reducing and unloading valves.
- 07.08 Construct and troubleshoot hydraulic circuits using accumulators.
- 07.09 Construct and troubleshoot a regenerative hydraulic circuit and a hydraulic circuit using remote control.
- 07.10 Construct and troubleshoot hydraulic circuits for deceleration and braking.
- 07.11 Identify the components of pneumatic systems and describe their functions.
- 07.12 Troubleshoot and repair pneumatic valves, compressors, pumps and regulators.
- 07.13 Analyze and define gas pressure storage and force in basic pneumatic circuits.
- 07.14 Construct and troubleshoot pneumatic circuits and systems.

08.0 DEMONSTRATE PROFICIENCY IN MECHANICAL POWER TRANSMISSION SYSTEMS--The student will be able to:

- 08.01 Utilize precision measuring instruments.
- 08.02 Construct and align mechanisms to demonstrate displacement, velocity and torque ratios.
- 08.03 Construct and troubleshoot compound and reverted gear trains.
- 08.04 Construct and troubleshoot internal and planetary gear trains.
- 08.05 Construct and troubleshoot helical and bevel gear trains.
- 08.06 Construct and troubleshoot rack and pinion, worm and wheel and block and screw mechanisms.
- 08.07 Analyze, construct and troubleshoot counter rotating mechanisms and differentials.
- 08.08 Construct and troubleshoot spring mechanisms, pulley blocks and differential hoists.
- 08.09 Construct and troubleshoot chain, belt and disc drives and universal joints.
- 08.10 Construct and troubleshoot clutch and coupling mechanisms.
- 08.11 Troubleshoot and replace bearings, bushings and cams.
- 08.12 Apply proper lubrication to mechanical system components.

09.0 DEMONSTRATE PROFICIENCY IN MECHANISMS, LINKAGES AND LEVERS--The student will be able to:

- 09.01 Construct clutch and brake mechanisms.
- 09.02 Construct class one, two, three and compound levers.

09.03 Construct and troubleshoot rocker arm and bell crank linkages and combined mechanisms.
09.04 Construct and troubleshoot four-bar mechanisms (crank, rocker and double rocker).
09.05 Construct and troubleshoot drag link and intermediate mechanisms.
09.06 Construct and troubleshoot four-bar variations.
09.07 Construct and troubleshoot cam mechanisms.
09.08 Construct and troubleshoot pivoted follower mechanisms.
09 09 Analyze, construct and troubleshoot toggle, quick return and ratchet mechanisms.
09.10 Construct and troubleshoot harmonic drives.
09.11 Construct and troubleshoot geneva mechanisms.

10.0 DEMONSTRATE PROFICIENCY IN TRANSDUCERS AND INSTRUMENTATION--The student will be able to:

10.01 Measure fluid flow and liquid levels with transducer circuits.
10.02 Utilize operational amplifier circuits for transducer applications.
10.03 Construct and utilize circuits for thermal sensing devices.
10.04 Set up and test strain gage circuits.
10.05 Utilize pressure transducers to monitor hydraulic and pneumatic circuits.
10.06 Utilize acceleration transducers.
10.07 Utilize positional transducers.
10.08 Construct and troubleshoot circuits for sound transducers.
10.09 Set up and operate transducer recording devices.

11.0 DEMONSTRATE PROFICIENCY IN VIDEO SYSTEMS--The student will be able to:

11.01 Define the principles of video signal generation.
11.02 Analyze and troubleshoot TV power supplies.
11.03 Analyze and troubleshoot sweep circuits.
11.04 Analyze and troubleshoot high voltage circuits.
11.05 Analyze and troubleshoot video circuits.
11.06 Analyze and troubleshoot sync circuits.
11.07 Align color monitors for proper operation.
11.08 Analyze and troubleshoot RF tuners.
11.09 Analyze and troubleshoot video monitor sound circuits.
11.10 Analyze and troubleshoot color circuits.
11.11 Interconnect video system components using coaxial cables.

12.0 DEMONSTRATE PROFICIENCY IN STATICS AND INDUSTRIAL MATERIALS--The student will be able to:

12.01 Define and measure forces and loads in structures using a ring force transducer.
12.02 Define and measure moments of forces and loads in structures.
12.03 Define and measure the mechanical properties, tensile strength, modules of elasticity and hardness of materials.
12.04 Calculate and measure the strength of beams, connectors and joints in mechanisms and structures.
12.05 Define and measure the effects of heat treating and aging on the properties of materials (Rockwell, Brinell, tensile testing).
12.06 Identify the effects of corrosion and electroplating on materials.
12.07 Define and measure the properties of plastic materials.

13.0 DEMONSTRATE PROFICIENCY IN AUTOMATIC CONTROLS AND ROBOTICS--The student will be able to:

13.01 Utilize complex motor control circuits including variable frequency drives.
13.02 Analyze and interpret complex ladder diagrams.
13.03 Analyze the operation of programmable controllers.
13.04 Develop programs for programmable controllers.
13.05 Specify and utilize various sensor devices.
13.06 Analyze the operation of robotic work cells and support equipment.
13.07 Analyze and troubleshoot specific robot systems.
13.08 Analyze and implement robotic software programs, and explain pendant operations.
13.09 Interface robot systems with other automatic equipment.
13.10 Troubleshoot and repair automation control systems.

PROGRAM IMPLEMENTATION

It is the teacher's responsibility to ensure that students learn how to competently perform the tasks specified in the course objectives. Therefore, the teacher must lead the students through the learning experiences in a course, motivate students, act as a role model for students, and at times, function as a guidance counselor and placement coordinator. This leadership role requires the teacher to participate in many of the activities required for program implementation. The teacher must select the methods of instruction that best apply to students' ability levels, measure student achievement and provide feedback. Key factors that must be considered when implementing this program are addressed below.

TEACHER CHARACTERISTICS

Subject Knowledge

The teacher must be a subject matter expert who is able to implement sound instructional methods and evaluate student performance. He/she must have significant work experience in the industry/vocational field and be able to communicate that knowledge to the students.

Instructional Delivery

The teacher's role in the learning process is to motivate and lead the student as well as impart subject matter knowledge. In order to maximize student learning, the use of a variety of instructional methods is encouraged. Because teaching styles vary greatly, teachers are highly encouraged to "pick and choose" from various methods or to combine methods for maximum benefit to students. Some of the more traditional methods used are lecture, demonstration and small group instruction. Other teaching methods which are suggested for further exploration include individualized self-paced, open-exit/open-entry, contract, computer based and competency based instruction. The focus of Competency Based Vocational Education (CBVE) is to ensure that each student can competently perform tasks specified before progressing to more complex skills.

CONVENTIONAL INSTRUCTIONAL METHODS

A vocational program may require a portion of the instruction to be presented in a standard lecture or controlled demonstration format. These methods of instruction can be easily combined with instructor controlled step-by-step practical exercises. Some instructional activities may dictate that this instructional approach be used to introduce students to hazardous equipment often utilized in vocational training. In most situations, students should be required to perform specified activities to achieve maximum skill competency. If mastery of a task is required, competency based education methods may be more appropriate. However, if the training activity involves an orientation or a seldom performed, non-essential task, conventional instructional methods may be more effective. Teachers are encouraged to use a variety of instructional methods to best meet instructional objectives.

Instructional Development

Teachers often must develop and select their own teaching and curriculum materials. In developing a comprehensive curriculum, instructional objectives based upon both the performance and cognitive domain must be included. When developing curriculum materials, teachers must use the curriculum framework (CF) and student performance standards (SPS) contained in this program guide as a basis. These materials delineate minimim program content which must be presented for an approved vocational training program. However, they are not intended for use as a comprehensive curriculum. Be certain not to adapt the curriculum to available materials, but select only those materials which can be adapted to the curriculum.

Instructional Measurement

Teachers must select testing methods that support the instructional delivery system used. Teachers must be competent to develop, administer and evaluate written and performance type tests.

Student Admissions Criteria

Providing the student the opportunity to successfully complete a vocational education program, in any institution, should be the primary concern of the instructional effort. Therefore, it is very important to direct planning and effort into identifying and selecting students with excellent potential for success in the educational program and in the occupation. The school's primary task is to prepare people for fulltime, entry-level positions as technicians or, in the case of those with more experience, as managers.

The Course Code Directory, specifies grade levels at which occupational programs are offered. Specific student admissions criteria which are required by the State and local educational agencies for the Electromechanical Technology training program are illustrated as follows.

SPECIFIC ADMISSIONS CRITERIA

Minimum Age:	As required by state and local policy
Physical Requirements:	None
Special Requirements:	None
Minimum Basic Skills Math Level:	* 10.0
Minimum Basic Skills Language Level:	* 9.0

* This grade level requirement is specified in the Curriculum Framework and is applicable to postsecondary level programs of 450 hours or more only. There is no minimum basic skill requirement for secondary programs.

THE STUDENT PROFILE

Developing a student profile is an important step in program implementation. Attention should focus on student characteristics that can be remediated within a training program, but could create serious impediments to success in the vocational field. Typical of these would be deficiencies in communication and mathematical skills. The basic skill levels can be measured by testing. Test results can then be used to direct the student to more suitable training which matches his or her skill level, or to determine supplemental training which may be required to increase chances for student success.

High school and postsecondary vocational students can be admitted to a vocational program upon request if they meet any specified prerequisites, such as physical or basic skill requirements. Training programs should be accessible to as many students as possible. Training programs are designed to prepare students for employment upon graduation, or serve as prerequisite to a postsecondary program.

The community college can be more selective and establish stringent admission standards. This may be done by assessing applicants or by recruiting potential students who meet the established prerequisite requirements of the training. The program advisory committee can design a profile of the potentially successful student. The profile should contain a

list of qualities, traits and aptitudes that will indicate a higher potential for student success. Acceptable levels for these traits must also be determined. For example, the qualities deserving highest attention, mechanical ability and cognitive aptitude, are those which the educational program itself will not likely be able to influence, although these traits should have considerable weight in establishing the basic profile. Deficiencies in mathematical or communication skills may lend themselves to improvement through related instruction while the student is enrolled in the program. The following example illustrates specific qualities to consider when establishing the student profile:

Mechanic/Technician--Service

- Knowledge of basic tools and equipment used by mechanics/technicians
- Ability to analyze and solve mechanical and technical problems
- Ability to interpret written mechanical/technical materials
- Ability to interpret mechanical/technical drawings
- Mechanical dexterity

Mechanic/Technical Service Management

- Basic application of service
- Business skills
- Ability to work with people
- Communication skills
- Leadership

QUALIFYING AND PRETESTING

Assessing potential students for vocational programs is an integral part of the recruiting process since considerable amounts of time and money will be spent on students entering training. Recruiters must have a good idea of the candidate's basic aptitude. Whoever guides the candidate to the program needs to have knowledge of the student's interests, abilities and experience. These can be measured by a variety of assessment methods, which should be performed upon program entry. The assessment can help determine extent and level of training each individual should receive.

The minimim basic skills requirement for mathematics and language skills is specified on the curriculum framework. Assessment should determine the level at which the student can read, write, calculate mathematics and understand the English language. It is appropriate for the program advisory committee and the school to develop some selection criteria based on minimum skill levels. These criteria should remain flexible in order to maximize educational opportunity for all applicants. Additionally, vocational educators must make every effort to serve the variety of "special needs" students and to eliminate sex-bias and stereotyping in all occupational areas.

ADVISORY COMMITTEE

It is imperative that representatives of industry be organized into an advisory committee. Constantly changing technological demands of our society will continue to stimulate changing industrial patterns. Therefore, effective use of program advisory committees is vital to the successful implementation of vocational training programs. Advisory committees provide expert technical advice which is not easily obtainable elsewhere, offer external support of policies and have tremendous public relations potential.

The most effective advisory committees are those whose members have mutual respect for each other's abilities and vested interest in the training program because of their need for trained workers. The program advisory committee is also one of the most effective means of facilitating placement. Its role can be:

- To contact local industry and encourage them to use the school's placement office as a means of filling jobs
- To develop an effective procedure for interviewing and evaluating potential employees suggested by the school
- To assist in gathering accurate and current job information as it becomes available

COUNSELING AND GUIDANCE

Counseling of students serves two purposes. It guides the student into the program and it supports enrolled students on a continuing basis throughout the program. Much day-to-day counseling will be the responsibility of the teacher. The teacher has the most contact with the student and is in a position to detect and correct a problem. Each student will encounter new problems as the program develops. The teacher's job is to work with the student to help identify problems and then strive for solutions. The teacher will provide much of the counseling that focuses on trade knowledge and skills.

The professional counselor cannot be expected to have the subject matter expertise of the primary teacher. The counselor, however, can focus on the student's needs related to other issues such as personal growth, interests and attitudes. The ideal situation will provide at least one counselor with current knowledge of industry standards for career counseling. A useful tool which should be used in the counseling process is the Career Merit Achievement Plan (Career MAP) which presents minimum instructional content keyed to student performance standards. Career MAPs are available for each industrial program area, and can be used to document student achievement, isolate student interests, talents and weaknesses. They are also useful for placement purposes. Information on Career MAPs may be obtained by contacting the Department of Education, Division of Vocational, Adult, and Community Education, (904) 488-0484.

STUDENT PLACEMENT

Implementing an effective placement system is integral to developing a successful vocational training program. **S.B.E. Rule 229.551 (3)(g)** requires 70 percent placement of students who have completed a vocational training program. Although placement is not always a problem, as with students already working in a related occupation, the placement program should place emphasis upon students who are seeking entry-level employment since these students have little or no experience with industry.

The task of the placement program is to locate job openings in the community. The placement coordinator or teacher must know each student's personal aims and interests in addition to the information stated on the achievement record. In many cases, teachers are the best source to match students to job openings because of their contacts with the industry advisory committee. Input concerning employment openings must come from individual business establishments in the community. The placement coordinator should introduce a student to as many suitable job openings as possible. Conversely, employers can then be expected to interview as many qualified candidates as possible.

Cooperative Education

COOPERATIVE EDUCATION APPLICABILITY

Normally, a student will complete the entire program as a full-time student before obtaining employment as an electromechanical technician. However, there may be situations where a student could be allowed to complete part of the program while employed as an electromechanical technician. At this time it is appropriate for the student to enroll in industrial cooperative education (ICE). Guidelines for this training plan are provided in the "Industrial Cooperative Education Program Guide," published by the Division of Vocational, Adult, and Community Education, Order # IE 508 BK 87.

Industrial cooperative education is a method of instruction designed to prepare students for jobs in the community. This method is a joint effort between the school and the business community. Student trainees receive a combination of instruction in the classroom and related on-the-job training through employment. Learning experiences are jointly planned and supervised by the teacher and the employer. Cooperative education is relevant to the needs of the student preparing for a work role, and will help the student to achieve success and personal satisfaction as the transition is made from school to the constantly changing world of work.

Cooperative education is defined in the Federal Register, Volume 39, number 143, Vocational Education, Section 102.96, as a program ". . . to prepare students for employment, through: (a) providing meaningful work experiences combined with formal education enabling students to acquire knowledge, skills, and appropriate attitudes, (b) removing the artificial barriers which separate work and education, (c) involving educators with employers, creating interaction whereby the needs and problems of both are made known, thereby making it possible for occupational curricula to be revised to reflect current needs in various occupations . . . ."

PURPOSE

Cooperative Education is for persons who, through written cooperative arrangements between the school and employers, receive instruction, including required academic courses and related instruction by alternation of study in school with a job in any industrial occupational field. These two experiences must be planned and supervised by the school and employers so that each contributes to the student's education and employability. Work periods and school attendance may be on alternative half days, full days, weeks or other periods of time to fulfill objectives of the cooperative education program.

GOALS AND OBJECTIVES

The primary goal of the cooperative method of vocational education is to prepare skilled, responsible individuals who can assume a productive role in the community. Specific objectives to meet the primary goal are:

- To prepare individuals for employment, adjustment and advancement in specified occupations or occupational areas (primary objective)
- To provide an understanding of the contribution of work to the social and economic welfare of our nation
- To provide students with an understanding and appreciation of the American free enterprise system
- To foster an awareness of the civic, social and moral responsibilities of individuals to society

- To stimulate students' interest in their chosen occupational fields and provide an understanding of the opportunities in each field
- To provide training that results in increased efficiency in performing job tasks
- To provide curriculum which is sensitive and adaptable to changes in occupational practices and procedures as they are affected by societal, economic, technical and educational developments
- To strive to develop a greater appreciation of the value of specifically trained personnel among employers, employees and consumers
- To reinforce skills learned in the school laboratory
- To provide experiences on tools and equipment not available in the school laboratory
- To supplement and broaden the school curriculum into areas not otherwise available

Student Organization Participation

Vocational student organizations operate pursuant to federal and state laws, which authorize them as viable components of vocational education programs. According to federal regulations, the vocational education program of instruction may include activities of vocational student organizations which are an integral part of the vocational instruction offered and which are supervised by vocational education personnel. The **S.B.E.** Rules authorize vocational student organizations as an integral part of the vocational education program as stated in **S.B.E. 6A-6.064 (7)** and **6A-6.065 (8).**

VOCATIONAL INDUSTRIAL CLUBS OF AMERICA (VICA)

VICA is an organization for secondary or postsecondary students enrolled in trade and industrial education programs in high schools, area vocational technical centers and junior and community colleges. It is the only national and international organization for trade and industrial students. The organization is designed to expand and enrich opportunities for leadership, social awareness and civic responsibility in vocational students.

Students who participate in VICA activities are often better prepared for the world of work. They acquire knowledge of the many opportunities available in their chosen careers and become aware of the value of their

contributions to society. They are also given opportunities to develop and utilize their talents and abilities in ways that otherwise would not be available to them.

BENEFITS OF VICA MEMBERSHIP FOR THE STUDENT

Membership in VICA offers the student the opportunity for growth and development in the following areas:

School and Community Service Activities Students in VICA become involved in various school and/or community services. These may include clothing or food collections for the needy, donation of time and service to the elderly and participation in fund raisers or similar activities.

Social Interaction with Fellow Students Activities are also available that offer students time for relaxation and fun. Social activities of this type may be held on a regular basis. They might be held on the school campus during school hours, or off campus after school. More formal functions would include end of the year award banquets or industry/employer appreciation dinner banquets.

Competition in Skill and Leadership Contests VICA offers various contests in all the skill and leadership areas it serves. Often, teachers identify talented students who represent their school in regional competitions. However, any student member of VICA may compete. Instructors should conduct planned contests within their trade areas. This also pertains to leadership areas. First and second place regional winners then move on to the state level contest. The state winners then compete at the national level of the United States Skill Olympics.

INSTRUCTIONAL RESOURCES

STUDENT REFERENCE MATERIALS

Necessary instructional texts or pertinent material should be available for each student to satisfy training objectives. When textbooks are used, the copyright date should be as current as possible.

SERVICE MANUALS

Manuals with current manufacturer's service procedures and specifications should be available. These manuals must be located where students can use them while working in the shop area.

PERIODICALS

Current general and technical magazines and newspapers should be available for student and instructor use.

The following list of suggested resources is organized under each outcome shown in the curriculum framework. These resources have been recommended by instructors and program administrators.

01.0 DEMONSTRATE PROFICIENCY IN ELECTRONIC AND MECHANICAL BLUEPRINT READING

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE
How to Read Blueprints F. W. Dodge	McGRAW-HILL BOOK COMPANY	text
Machine Trades Blueprint Reading Ihne	AMERICAN TECHNICAL PUBLICATIONS, INC.	text

02.0 DEMONSTRATE PROFICIENCY IN ELECTRONIC COMMUNICATIONS CIRCUITS

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE
Communications Standards Dictionary Martin H. Weik	VAN NOSTRAND REINHOLD COMPANY, INC.	text
Electronic Communications Shrader	McGRAW-HILL BOOK COMPANY	text
Microwave Communications Morris Tischler	SCIENCE INSTRUMENTS COMPANY	text

03.0 DEMONSTRATE PROFICIENCY IN ADVANCED MICROPROCESSORS

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE
Data Communications William L. Schweber	McGRAW-HILL BOOK COMPANY	text
Microprocessor Interfacing	HEATH/ZENITH EDUCATIONAL SYSTEMS	text

04.0 DEMONSTRATE PROFICIENCY IN COMPUTER SOFTWARE APPLICATIONS

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE
Microprocessing Fundamentals, Hardware and Software Edward V. Ramirez, Melvyn Weiss	McGRAW-HILL BOOK COMPANY	text

05.0 DEMONSTRATE PROFICIENCY IN MOTORS AND MOTOR CONTROL CIRCUITS

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE
Electric Motor Controls (text and workbook) Rockis, Mazur	JOHN WILEY & SONS, INC.	text
Fundamentals of Automatic Control Robert C. Weyrick	McGRAW-HILL BOOK COMPANY	text
National Electrical Code	NATIONAL FIRE PROTECTION ASSOCIATION	text

06.0 DEMONSTRATE PROFICIENCY IN LASER ELECTRO-OPTICS

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE
Laser Technology (text and workbook)	HEATH/ZENITH EDUCATIONAL SYSTEMS	text
Opto Electronics (text and workbook)	HEATH/ZENITH EDUCATIONAL SYSTEMS	text

Opto Electronics, Fiber Optics Communications Morris Tischler	SCIENCE INSTRUMENTS COMPANY	text

07.0 DEMONSTRATE PROFICIENCY IN HYDRAULIC AND PNEUMATIC SYSTEMS

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE
Fundamentals of Fluid Mechanics Evett, Liu	McGRAW-HILL BOOK COMPANY	text
Hydraulics	PARKER HANIFIN CORPORATION	text
Hydraulics	VICKERS, INC. TECHNICAL TRAINING CENTER	text
Hydraulics *(text and workbook)*	AMATROL INC.	text
Pneumatics	PARKER HANIFIN CORPORATION	text
Pneumatics *(text and workbook)*	AMATROL INC.	text

08.0 DEMONSTRATE PROFICIENCY IN MECHANICAL POWER TRANSMISSION SYSTEMS

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE
Electromechanisms, Gears and Drives Terc Electromechanical Staff	DELMAR PUBLISHING	text
Mechanics and Materials for Design Nathan H. Cook	McGRAW-HILL BOOK COMPANY	text

09.0 DEMONSTRATE PROFICIENCY IN MECHANISMS, LINKAGES AND LEVERS

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE
Mechanisms, Linkages and Levers Terc Electromechanical Technology Staff	DELMAR PUBLISHING	text

10.0 DEMONSTRATE PROFICIENCY IN TRANSDUCERS AND INSTRUMENTATION

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE
Instruments and Measurements Charles M. Gilmore	McGRAW-HILL BOOK COMPANY	text
Transducers Theory and Applications	RESTON PUBLISHING COMPANY, INC., A Prentice-Hall Company	text

11.0 DEMONSTRATE PROFICIENCY IN VIDEO SYSTEMS

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE
Introduction to Television Servicing Wayne Brandenburg	McGRAW-HILL BOOK COMPANY	text
Video Systems, TV Principles and Servicing Badrkhan	JOHN WILEY & SONS, INC.	text

12.0 DEMONSTRATE PROFICIENCY IN STATICS AND INDUSTRIAL MATERIALS

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE
Applied Strength of Materials Jensen, Chenoweth	McGRAW-HILL BOOK COMPANY	text
Plastics Technology Robert V. Milby	McGRAW-HILL BOOK COMPANY	text

13.0 DEMONSTRATE PROFICIENCY IN AUTOMATIC CONTROLS AND ROBOTICS

TITLE, AUTHOR, ORDER#	PUBLISHER	TYPE
Computer Automated Manufacturing John H. Powers	McGRAW-HILL BOOK COMPANY	text
Concepts of Angular Position Control	LAB VOLT, Division of Buck Engineering Co., Inc.	text
Concepts of Linear Position Control	LAB VOLT, Division of Buck Engineering Co., Inc.	text
Industrial Electronics and Robotics Schuler and McNamee	McGRAW-HILL BOOK COMPANY	text
Robot Applications	HEATH/ZENITH EDUCATIONAL SYSTEMS	text

PUBLISHERS' ADDRESSES

AMATROL INC.
Post Office Box 2697
Jeffersonville, IN 47131
812 288-8285

AMERICAN TECHNICAL PUBLICATIONS, INC.
1155 West 175th Street
Homewood, IL 60430
800-323-3471

CONSOLIDATED PUBLISHING COMPANY
216 West 10th Street
Anniston, AL 36201
205-236-1551

DELMAR PUBLISHING
2 Computer Drive West
Albany, NY 12212
518-459-1150

FLORIDA DEPARTMENT OF EDUCATION, DIVISION OF VOCATIONAL EDUCATION
Knott Building
Tallahassee, FL 32301

HEATH/ZENITH EDUCATIONAL SYSTEMS
Post Office Box 167
St. Joseph, MI 49085

INTERNATIONAL LABOUR OFFICE
ILO Branch Office
1750 New York Avenue, NW
Washington, DC 20006

JOHN WILEY & SONS, INC.
605 Third Avenue
New York, NY 10158
212-850-6418

LAB VOLT, Division of
Buck Engineering Co., Inc.
Post Office Box 686
Farmingdale, NJ 07727

MERRILL PUBLISHERS
1300 Alum Creek Drive
Columbus, OH 43216
800-848-6205

McGRAW-HILL BOOK COMPANY
1221 Avenue of the Americas
New York, NY 10020
212-512-2000

NATIONAL FIRE PROTECTION ASSOCIATION
Batterymarch Park
Quincy, MA 02269
800-344-3555

PACE, INC.
9893 Brewers Court
Laurel, MD 20707

PARKER HANIFIN CORPORATION
17325 Euclid Avenue
Cleveland, OH 44112
216-531-3000

RESTON PUBLISHING COMPANY, INC., A Prentice-Hall Company
200 Old Tappan Road
Old Tappan, NJ 07675
201-767-5054

SCIENCE INSTRUMENTS COMPANY
6122 Resisterstown Road
Baltimore, MD 21215
301-358-7810

SMALL BUSINESS
ADMINISTRATION
Office of Inspector General
Washington, DC 20416
202-653-7557

VAN NOSTRAND REINHOLD
COMPANY, INC.
7625 Empire Drive
Florence, KY 41042
606-525-6600

VICKERS, INC., TECHNICAL
TRAINING CENTER
1332 Anderson Road
Clawson, MI 48017

FACILITIES

Facility Design Recommendations

Facilities, tools and equipment are essential parts of training programs, and must be designed to meet State program standard requirements and instructional objectives. This section of the Program Guide contains information for setting up classroom and laboratory facilities. Facility design criteria and space requirements are specified in **S.B.E. Section B, Chapter 6A-2**.

TEACHING FACILITIES

The instructional environment should duplicate, as closely as possible, the real-life work environment the student will enter after graduation. The more the school resembles the industrial environment, the easier it will be for the student to make the transition from school to work. Tools, supplies and equipment should conform to local industry standards. The teacher should actively pursue supplemental resources to expose the students to state-of-the-art equipment.

All facilities should include classroom space, as well as space for regular classroom equipment such as audio-visual equipment. Laboratory facilities should be equipped with work stations or workbenches, tables, chairs and special training aids to demonstrate basic principles and theory. They should contain enough tools and equipment to enable several students to work individually on the same learning activity.

UPDATING FACILITIES

To keep pace with technological changes and improvements, facilities must be updated on a continuing basis. When planning facilities, priority must be given to provide space which will fulfill changing needs of the instructional program. Buildings should be designed with flexibility to expand in order to accommodate future program changes and to allow for greater ease of facility updating. The program advisory committee should be used to assist the school in establishing priorities for obtaining facilities, tools and equipment. Careful planning and analysis of current and future needs will lead to the establishment of an effective training environment.

SCHOOL FACILITIES

Electromechanical Technology Classroom/Laboratory Areas

This section of the program guide provides guidelines for Electromechanical Technology program facilities. All vocational programs must meet additional facility requirements specified in **S.B.E. Section B, Chapter 6 A-2**.

Laboratory facilities for this program should be designed to accommodate oversized equipment. Areas are needed for operating and troubleshooting electrical motors and automatic control panels, hydraulic systems, pneumatic systems, laser electro-optic systems, mechanical drives and conveyor systems, computers, communications equipment and robotic systems. Work benches or tables should be provided for each of these areas. Separate rooms may be required for activities involving industrial size hydraulic, pneumatic, laser electro-optic and robotic systems. A storage area is needed for an air compressor servicing the pneumatic equipment. Pressure service lines and hoses should be installed in the laboratory to provide air pressure to automatic and robotic equipment.

The laboratory should include electrical outlets providing 110 volts at each work station. Electrical outlets should be permanently mounted to the work station benches. Additional electrical outlets should be installed along the walls and in the center areas of the laboratory. Electrical outlets in the center areas should be mounted on posts between the ceiling and work stations or on pull down extension systems. Special electrical wiring may be required to supply the power requirements of specialized equipment. All electrical service must be installed according to local building code requirements.

CLASSROOM/LABORATORY FACILITIES

Space requirements for **new** facility construction for this program are specified in **S.B.E. Rule 6A-2.032** as shown below.

NEW FACILITIES ELECTROMECHANICAL TECHNOLOGY	
Occupant Design Stations	20
Net Square Feet Per Occupant	
Minimum	110
Normal	115
Maximum	120
Total Net Square Feet	
Minimum	2200
Normal	2300
Maximum	2400

Additional related space is suggested when available.

ADDITIONAL RELATED SPACE
Total Net Square Feet

	Minimum	Normal	Maximum
Automated Controls Laboratory	1800	2000	2200
Transducers Electronics Laboratory	1800	2000	2200
Hydraulics and Mechanical Laboratory	1800	2000	2200
Laser/Electro Optics Laboratory	2000	2200	2400
Automated Manufacturing Laboratory	1800	2000	2200
RF Communications Laboratory	1200	1400	1600
High Reliability Soldering Assembly	2200	2400	2600
Video Circuits Laboratory	1600	1800	2000
Physics Laboratory	1900	2100	2300

WORK STATION ARRANGEMENT

The arrangement of work stations and specialized equipment depends upon the general layout of the facilities, but careful consideration must be given to convenience to entrances and exits, easy movement among work stations and tool/storage areas. The area should have a counter convenient to work stations. Overall layout of the facility should be planned so that the location of entrances and exits permits a logical flow of work in progress. One of the most critical factors in planning a facility is the arrangement of work stations to obtain a safe, efficient traffic pattern.

ADDITIONAL FACILITY CONSIDERATIONS

Training Stations

Training stations and live work areas must be available in the type and number required to meet program goals and performance objectives.

Instructional Area

A classroom or designated area of the laboratory should be available for lecture, instruction, viewing audio visual materials and other nonshop activities.

Personal Tool/Equipment Storage Area

A secure storage room or area should be provided, with enough shelf space for student supplies/tool boxes and floor space for equipment.

General Storage

Storage areas for tools, parts, supplies and machines must be sufficient to support the activities outlined in the program goals and performance objectives.

Office Space

An area separate from the classroom and laboratory should be available and convenient for use by the instructor(s) as an office.

Maintenance

A regular facilities maintenance program must be implemented to ensure that equipment and facilities are safe and usable to meet instructional needs.

Housekeeping

The classroom, laboratory and support area(s) must be kept clean and orderly.

Ventilation

A fume/dust removal system should be in place and operable. When appropriate, heating and cooling systems should be used to provide sufficient comfort for learning. Ventilation requirements are stated in **S.B.E. Rule 6A-2.066**.

First Aid

A first aid station must be in place, well marked and complete with appropriate supplies.

Support Facilities

Restrooms, clean-up areas and lockers convenient to the shop should be available for students.

Safety

The facilities must meet all Occupational Safety and Health Administration (OSHA) safety standards, where applicable.

Facility Evaluation

The program advisory committee should be asked to conduct an annual evaluation of the facilities to ensure the program's continuing capability to meet instructional objectives.

Safety, Maintenance and Liability

SAFETY

S.B.E. Rule 6A-2.097

The Florida State Board of Education establishes rules for the operation of public schools. **Part III, Section B, Chapter 6A-2** of the State Board of Education Rules contains the standards for existing educational facilities. Subsections deal with the entire school facility in regard to such topics as electrical equipment, flammable materials, ventilation, fire safety, storage and illumination. Subsection 6A-2.097 contains safety regulations pertaining to vocational classes.

The statute requires 100 percent protection of every student and teacher participating in laboratory work wherein the type of activities listed in the statute above are conducted. This will include: demonstration by teachers or students, students and teachers present in a room or laboratory when students are engaged in make-up work or project work, and when anyone is using tools for construction or repair work involving the shaping or cutting of any solid materials.

Rules and regulations for an eye protection program should be organized and distributed to teachers, students and school personnel. Safety devices should be worn by those participating in the activity and by those who are observers or who may be in close proximity.

Safety hazards present in the Electro Mechanical Technology program include the possibility of electric shock, touching hot electrical components, being hit by sparks or materials from exploding electrical components, or injury from laser systems and robotic systems.

Special instructions should be provided to students concerning the following safety hazards.

1. Electric shock
   A. How to avoid electrical shock
   B. What to do for individuals who are subjected to electrical shocks

2. Burns
   A. How to identify and handle hot electrical components
   B. Treatment of minor burns

3. Exploding materials
   A. Causes of explosions and types of components likely to explode
   B. Protection from flying materials

4. Radio transmission injury
   A. Types of potential injury from radio transmitters
   B. Protective measures to avoid injury from radio transmitters

Marking of Hazardous Areas

Floors, walls, posts, stationary objects, machinery and equipment should be properly painted, marked, coded or identified, according to recommended safety practices of OSHA, the school board and industry.

Emergency Procedure For Injuries

The following procedures are recommended in the event of an injury or sudden illness in a student:

- Refer to the red "fire or medical emergency" signs posted in appropriate areas.
- Provide immediate first aid if so qualified.
- Notify appropriate personnel to advise them of the problem. They can also contact emergency trained personnel on campus.
- A conscious person has the right to refuse treatment and/or transportation to a medical facility.
- Advise students that they will be financially responsible for ambulance and emergency care.
- The paramedics will assume patient care upon arrival.
- If emergency transportation is not indicated, the student may spend time at the clinic, be allowed to go home or go to a medical facility.
- Be sure to complete the appropriate student injury form for any and all accidents or sudden illness.

MAINTENANCE

Schools should have the necessary facilities for routine maintenance. Special maintenance requirements for this program concern the hand and power tools and machines. Arrangements must be made to accomplish routine and non-routine maintenance of hand and power tools and cutting and shaping machines. Arrangements can be made through the school's shop or an outside agency.

VOCATIONAL TEACHER LIABILITY

Liability of Teacher and School Board

Negligence of vocational education teachers can cause unnecessary injury, and may result in teacher and school district liability. Vocational teachers are recommended to carry personal liability insurance. To reduce the risk of liability and injuries, the following suggestions are provided.

- Follow accepted policies of the school board.
- Do not allow students to use equipment or tools which have not been approved by the administration and Board of Education.
- Establish safety rules and enforce them.
- Do not leave the shop/laboratory while students are working.
- Do not permit non-enrolled students to use the shop/laboratory.
- Do not allow students to use machines or tools for which instruction has not been given.
- Do not approve unsupervised student activities inside or outside the shop/laboratory.
- Prepare accident forms for all accidents.
- Regularly inspect the workplace and equipment for defects or potential hazards and maintain documentation of unserviceable or hazardous items.
- Consider age, maturity, skill and ability of students when providing instruction and supervision.
- Administer safety tests to students upon completion of the demonstration of a specific machine, tool or process and keep documentation on file in your office.
- Require all students to wear eye protection devices, when appropriate, for laboratory activities.

SUGGESTED EQUIPMENT LIST

General Classroom Equipment

DESCRIPTION

Chalkboard

Bulletin board

Bookcases

Cabinet-storage

Student study stations

Audio-visual equipment as needed

Laboratory Tools and Equipment

These tools and items of equipment are normally used in this program. Equipment items are listed under each outcome, corresponding to the curriculum framework. Consumable supplies should be readily available to assure continuous instruction. Consumable supplies such as solder and wire are not contained in the equipment list.

01.0 DEMONSTRATE PROFICIENCY IN ELECTRONIC AND MECHANICAL BLUEPRINT READING

DESCRIPTION

Architecture rule
Electromechanical drawings

02.0 DEMONSTRATE PROFICIENCY IN ELECTRONIC COMMUNICATIONS CIRCUITS

DESCRIPTION

Analyzer, AM, FM, stereo (Sencor or equivalent)
Meter, standing wave radio (SWR)
Microwave trainer system (Science Instruments SIP 365, or equivalent)
Power meter
Radio, two way, AM, FM, radio SSB
Signal generator, RF, AM, FM and SSB
Signal generator, audio, sine and square wave
Spectrum analyzer (Tektronix or equivalent)
Workbench, electronic, with test instrument shelf

03.0 DEMONSTRATE PROFICIENCY IN ADVANCED MICROPROCESSORS

DESCRIPTION

EPROM programmer (Jameco or equivalent)
Logic analyzer, 40 channel (Hewlett Packard or equivalent)
Microprocessor interfacing training system (Heath/Zenith ETW-3400-A or equivalent)
Network analyzer
Personal computer training system (Heath/Zenith ETW-100/EWA-100 or equivalent)

04.0 DEMONSTRATE PROFICIENCY IN COMPUTER SOFTWARE APPLICATIONS

DESCRIPTION

Color monitor
Desktop computer, student station, double disk drive with 20 Mb hard disk drive (IBM XT/AT, Macintosh IICX or equivalent)
Mouse and joy stick controls
Printer (Imagewriter or equivalent)

05.0 DEMONSTRATE PROFICIENCY IN MOTORS AND MOTOR CONTROL CIRCUITS

DESCRIPTION

Brushless DC motor with controller
Dynomometer
Electric motors, single phase, three phase up to 5HP, DC and wound rotor motors
Motor control training system (ICT Industries or equivalent)
Motor starters, controllers, timers, various nema or european style
Photoelectric sensors
Proximity sensors
Stroboscope (General Instruments or equivalent)
Variable frequency drive controller, 5HP minimum (Allen Bradley or equivalent)
Workbench, motor control

06.0 DEMONSTRATE PROFICIENCY IN LASER ELECTRO-OPTICS

DESCRIPTION

Electro-optic training system (Heath/Zenith ET-3300)
Fiber optic light cables with connection terminals
Fiber optics cable inspection unit (Science Instruments SIP 376 or equivalent)
Fiber optics training system (Science Instruments SIP 375, or Heath/Zenith ET 3300 or equivalent)
Industrial laser system, 30 watt
Inferometer
Laser training system (Heath/Zenith EWS-4200 or equivalent)
Light reflection test unit
Mirrors, prisms and lenses with beam splitter and jig/fixtures
Optical power calibration meter
Optical x-y scanner (Precision Optical or Oriel or equivalent)
Optical vibration isolation bench
Photometer/light source generator (Science Instruments SIP 374 or equivalent)
Polarized modulator

07.0 DEMONSTRATE PROFICIENCY IN HYDRAULIC AND PNEUMATIC SYSTEMS

DESCRIPTION

Air compressor, 2HP minimum, with air lines, hoses and regulators
Hydraulic training system (Amatrol or equivalent)
Pneumatic training system (Amatrol or equivalent)
Pump, air, electric
Vacuum pump

08.0 DEMONSTRATE PROFICIENCY IN MECHANICAL POWER TRANSMISSION SYSTEMS

DESCRIPTION

Gear training system (Pic or equivalent)
Mechanical mechanisms training system (Pic or equivalent)
Micrometers, various sizes
Motors, small 1/16HP to 1/8HP, universal
Oil can
Pressure lubrication equipment
Strobotach (General Instruments or equivalent)
Vernier calipers

09.0 DEMONSTRATE PROFICIENCY IN MECHANISMS, LINKAGES AND LEVERS

DESCRIPTION

Clutch and brake training system
Mechanism, linkages and levers (Pic or equivalent)
Harmonic drive analyzer (Hewlett Packard 3308 or equivalent)

10.0 DEMONSTRATE PROFICIENCY IN TRANSDUCERS AND INSTRUMENTATION

DESCRIPTION

Recorder, chart plotter
Strain indicator (Measurements Group Inc. model P-3500 or equivalent)
Transducer amplifier, plug in unit (Tektronix or equivalent)

Transducer devices, various types, such as strain, pressure, temperature, level, flow acceleration, distance
Transducer power supplies (Tektronix or equivalent)

11.0 DEMONSTRATE PROFICIENCY IN VIDEO SYSTEMS

DESCRIPTION

Coaxial cables (RG-59U assorted lengths)
Digital multimeter, bench (Tripolett or equivalent)
Generator, all channel, sweep/marker (Leader model LAG-400 or equivalent)
Oscilloscope, 50 MHZ, 2 channel (Kenwood or equivalent)
Television set/monitor with BNC video inputs and industrial video connectors
Vector scope, NTSC (Leader model LVS-5850 or equivalent)
Video analyzer (Sencore or equivalent)
Video signal generator (Leader or equivalent)
Video sync test generator (Leader model LCG-400M or equivalent)
Wave form monitor (Leader model LBO-5860A or equivalent)

12.0 DEMONSTRATE PROFICIENCY IN STATICS AND INDUSTRIAL MATERIALS

DESCRIPTION

Metal load frame with weights
Oxyacetelene welding unit
Ring force transducer device
Tensile testing device
Tester, hardness (Rockwell or Brinell or equivalent)

13.0 DEMONSTRATE PROFICIENCY IN AUTOMATIC CONTROLS AND ROBOTICS

DESCRIPTION

Angular position control training system (Lab Volt or equivalent)
Auto controls, robotics
Conveyor system (Mori seki or equivalent)
CNC lathe 3 to 20HP (Mori seki SL1 or equivalent)
CNC mill 3 to 20HP (Mori seki or equivalent)

Dolly, heavy duty
Management system, CIM (Mori seki, Amatrol, GM or equivalent)
Programmable controller industrial system (Allen Bradley, GE, Square D, Gould Modicom or equivalent)
Programmable controller training system (Allen Bradley model 1745 Demo 1, SIC 100 or 150 or equivalent)
Robot, lathe loading (Mori seki or equivalent)
Robot, mill loading (Mori seki or equivalent)
Robot, six axis servoid, 6 pound payload minimum (GM Fanuc, Mitsubishi or equivalent)
Sensing elements, various for testing stations, such as vision system, proximity, gaging
X-Y position control training system (Lab Volt or equivalent)

PROFESSIONAL DEVELOPMENT

Teacher Technical Updating

Technical updating workshops are scheduled periodically throughout the State, usually in the summer months. Teachers should take advantage of the opportunity to attend the program technical update workshops when they are held. All instructional staff are encouraged to participate in as many training opportunities as possible.

Teachers should seek opportunities with local companies to maintain currency with industry trends. During periods when school is not in session, teachers are encouraged to make arrangements to return to industry for suitable involvement in their area of expertise.

Membership in professional associations offers vocational educators an enormous range of opportunities for working together to strengthen the field and to develop personal competence and satisfaction in work. The associations have similar goals and activities. They seek excellence in program content by means of joint efforts among members, communications that keep members current, forums for the discussion of issues in the field, useful and stimulating publications and sound professional growth experiences at local, state, regional and national meetings and annual conventions. They are concerned with increasing public understanding and support of the field. Teachers are encouraged to maintain affiliation with professional organizations. A list of professional organizations follows this section of the guide.

Teacher Standards

As a prerequisite to certification, teachers must have the required years of experience in the appropriate technical field as defined in the certification standards. For the Electromechanical Technology program, the requirements are six years continuous experience in electronics. The teacher is then judged qualified to teach upon meeting one of the following criteria: (1) regular or temporary Florida teacher's certificate with appropriate coverage, (2) approval of local school board consistent with adopted school policy or (3) regular or temporary Florida teacher's certificate with other than appropriate coverage (has met all occupational experience requirements prescribed as a prerequisite to appropriate certification and has been approved by the school board to teach

out-of-field). Refer to the Curriculum Framework for this program to determine the appropriate occupational specialization coverage required for certification.

Instructional staff must have technical competency and meet all State and local requirements for certification. Instructors should hold current, nationally recognized certification in the subject areas taught, if awarded. Beginning teachers must be enrolled in the State Beginning Teacher Program.

A systematic method of obtaining "substitute" instructors, approved by the school board, should be used to assure instructional continuity. An orientation session for substitutes should be held on a regular basis. The substitute should be a competent instructor in the occupational area and specific competencies taught.

Professional Organizations and Support Services

EDUCATION ORGANIZATIONS

AMERICAN VOCATIONAL ASSOCIATION (AVA)
1410 King Street
Alexandria, VA 22314
800-826-9972

FLORIDA ASSOCIATION FOR TRADE AND INDUSTRIAL EDUCATION, INC. (FATIE)
Florida Department of Education
Industrial Education - Vocational Division
Knott Building
Tallahassee, FL 32399
904-488-0484

FLORIDA VOCATIONAL ASSOCIATION (FVA)
1420 North Paul Russell Road
Tallahassee, FL 32399
904-878-6860

FLORIDA VOCATIONAL INDUSTRIAL CLUBS OF AMERICA (VICA)
Florida Department of Education
Knott Building
Tallahassee, FL 32399
904-488-0484

TRADE ORGANIZATIONS

This list contains trade associations and technical societies. Many offer training programs of some sort, either directly or through their member companies. Specific details should be requested in writing.

ARMED FORCES COMMUNICATIONS AND ELECTRONICS ASSOCIATION (AFCEA)
4400 Fair Lakes Court
Fairfax, VA 22033-3899
703-631-6178

NATIONAL ASSOCIATION OF RADIO AND TELECOMMUNICATIONS ENGINEERS (NARTE)
Post Office Box 15029
Salem, OR 97309
503-581-3336

ELECTRONIC INDUSTRIES ASSOCIATION
2001 Eye Street, Northwest
Washington, DC 20006
202-457-4900

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)
345 East 47th Street
New York, NY 10017
212-705-7867

COMPUTER AND COMMUNICATIONS INDUSTRY ASSOCIATION
666 11th Street, Northwest
Washington, DC 20001
202-783-0070

COMPUTER AND BUSINESS EQUIPMENT MANUFACTURING ASSOCIATION (CBEMA)
311 First Street, Northwest, 5th Floor
Washington, DC 20001
202-737-8888

COMPUTER AIDED MANUFACTURING INTERNATIONAL (CAM-I)
611 Ryan Plaza Drive, Suite 1107
Arlington, TX 76011
817-860-1654

COMPUTER AND COMMUNICATIONS INDUSTRY ASSOCIATION (CCIA)
1500 Wilson Boulevard, Suite 512
Arlington, VA 22209
703-524-1360

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
2101 L Street, Northwest, Suite 300
Washington, DC 20037
202-457-8400

AMERICAN ELECTRONIC ASSOCIATION (AEA)
2680 Hanover Street
Palo Alto, CA 94304
408-720-0117

ELECTRONICS TECHNICIANS ASSOCIATION, INTERNATIONAL (ETA-I)
604 North Jackson
Greencastle, IN 46135
317-653-8262

INSTITUTE FOR INTERCONNECTING AND PACKAGING
ELECTRONIC CIRCUITS (IPC)
7380 North Lincoln Avenue
Lincolnwood, IL 60646
312-677-2850

INTERNATIONAL SOCIETY OF CERTIFIED ELECTRONICS
TECHNICIANS (ISCET)
2708 West Berry, Suite #8
Fort Worth, TX 76109
817-921-9101

JOINT ELECTRONIC DEVICE ENGINEERING COUNCIL (JEDEC)
2001 Eye Street, Northwest
Washington, DC 20006
202-457-4971

NATIONAL ELECTRONIC SERVICE DEALERS ASSOCIATION (NESDA)
2708 West Berry Street
Fort Worth, TX 76109
817-921-9061

SEMICONDUCTOR EQUIPMENT AND
MATERIALS INTERNATIONAL (SEMI)
805 East Middlefield Road
Mountain View, CA 94043
415-964-5111

SEMICONDUCTOR INDUSTRY ASSOCIATION (SIA)
10201 Torre Avenue, Suite 275
Cupertino, CA 95014
408-973-9973

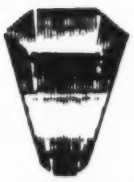
ROBOTIC INDUSTRIES ASSOCIATION (RIA)
Post Office Box 3724
900 Victors Way
Ann Arbor, MI 48106
313-994-6088

ROBOTICS INTERNATIONAL OF SME (RI/SME)
Post Office Box 930
Dearborn, MI 48128
313-271-1500

BIOELECTROMAGNETICS SOCIETY (BEMS)
Post Office Box 3729
Gaithersburg, MD 20878
301-663-4252

CONFERENCE ON PRECISION ELECTROMAGNETIC MEASUREMENT
National Bureau of Standards
Gaithersburg, MD 20899
301-569-4664

COMPUTER AND AUTOMATED SYSTEMS ASSOCIATION OF THE SOCIETY OF MANUFACTURING ENGINEERS (CASA/SME)
Box 930
One SME Drive
Dearborn, MI 48121
313-271-1500



State of Florida
Department of Education
Tallahassee, Florida
Betty Castor, Commissioner
Affirmative action/equal opportunity employer

IE564 BK-91

CAREER MERIT ACHIEVEMENT PLAN (CAREER MAP)

ELECTROMECHANICAL TECHNOLOGY

(0615.040300)

STUDENT'S NAME

State of Florida

An affirmative action/equal opportunity employer

DEPARTMENT OF EDUCATION
Betty Castor, Commissioner of Education

DIVISION OF VOCATIONAL, ADULT AND COMMUNITY EDUCATION
Robert S. Howell, Director

DEVELOPED BY:
University of South Florida
Department of Adult and Vocational Education

INDUSTRY-BASED PARTNERSHIP PROGRAMS: The State of Florida is committed to the development of industry-based partnership programs, designed by education and industry to respond to industry's demand for a highly skilled work force.

ACKNOWLEDGEMENTS

PARTNERSHIP WITH INDUSTRY

The following industry representatives are recognized, in addition to original industry members, for their valuable contributions to the identification and validation of the Electromechanical Technology competencies reflected in this MAP:

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Robert Klein, Honeywell, Inc.
Robert Ninker, Allen Bradley, Inc.
Morris Sedacca, E-Systems, Inc.
Domenick Tufariello, General Electric Neutron Services

For further information, contact
Bureau of Vocational Program and Staff Development
Division of Vocational, Adult, and Community Education
Department of Education
Knott Building
Tallahassee, FL 32399

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THIS MERIT ACHIEVEMENT PLAN RECORDS THE ELECTROMECHANICAL TECHNOLOGY ACHIEVEMENTS OF:

Student's Name _____

Student ID Number _____

Student's Address _____

_____

Initial Instructor _____

School _____

Date Started _____

PRIMARY JOB TITLE(S) FOR ELECTROMECHANICAL TECHNOLOGY

- Electronic Precision Assemblers OES#(93114859)
- Electromechanical Technicians DOT#(710.281-018)

Program completers qualify for the primary job title(s) listed above. Related job titles may be added based on those job titles found in industry and/or the Dictionary of Occupational Titles.

OVERVIEW

This Career MAP includes the competencies required for entry into the field of electromechanical electronics. Business and industry representatives have recommended that students in this field master these competencies in order to become employable. Local education agencies (LEAs) may adapt these competencies to meet their workforce needs.

PURPOSE OF THE MAP

The purposes of the MAP are: to display the student performance standards (SPS) required by the LEA and to document the level of achievement on student performance standards that the student demonstrates.

HOW TO USE THE MAP

Administrator and Instructor. The administrator and instructor can use Career MAPs in curriculum planning, program updating and improvement and teacher recruitment, selection and updating. If the LEA changes or adds student performance standards, the revised or additional student performance standards should be included in the blank boxes that appear within each intended outcome or at the end of this MAP.

Instructor. The instructor can use Career MAPs to keep track of student progress on student performance standards. By periodically reviewing the ratings on student performance standards, the instructor can identify a student's strengths and weaknesses and, on that basis, identify the skills for which the student needs remedial instruction or advanced training. The MAP can also be useful in student counseling and evaluation.

Co-op Instructor/Employer. The employer who sponsors a co-op program should use the Career MAP for keeping a record of the student's performance on appropriate standards. The MAPs will also help the co-op instructor/employer in counseling and evaluating the student.

Student. The student may use the MAP to show potential employers the performance standards he or she has mastered. In order to present a complete record, the student should encourage the instructor/co-op employer to rate his or her level of achievement on all the appropriate student performance standards and to fill in the verification form/cooperative work experience page in the back of this MAP.

Employer. The MAP shows an employer the student performance standards mastered by the student (a prospective employee) and the proficiency level achieved on each student performance standard. This information can help the employer make decisions about hiring, job assignments and job-training needs.

RATING STUDENT PERFORMANCE STANDARDS

Performance Competencies. Ratings on student performance standards should be based upon business/industrial performance standards. The evaluator observes and evaluates student performance as he or she would in the role of the employer or supervisor.

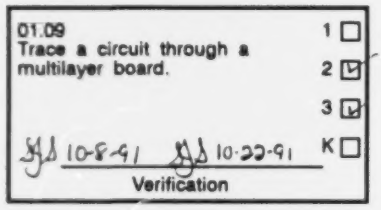
For each skill listed the learner receives a rating of 1, 2 or 3. Each rating indicates a particular level of achievement:

1 = Learner demonstrates knowledge and understanding of this student performance standard, but is not yet able to apply that knowledge or understanding.

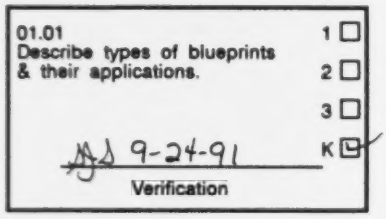
2 = Learner performs this student performance standard satisfactorily with only periodic supervision.

3 = Learner performs this student performance standard satisfactorily without supervision.

Whenever a performance standard is demonstrated, the instructor checks the appropriate rating box (1, 2 or 3) and initials and dates the verification line. If the student later demonstrates a higher level of achievement on a performance competency, the instructor checks the higher level and then enters his or her initials and the new date on the verification line, as shown in the following example:



Knowledge Competencies. For each SPS that is a knowledge competency only, with no manipulative skill involved, only one level of achievement is possible. If the student masters the competency, he or she receives a check in the bottom box ("K"), as shown below:



NOTE: A student performance standard without a checked rating indicates that the learner has not mastered the standard from lack of either ability, time, opportunity or need (the student's area of specialization may not have required it).

01.0 DEMONSTRATE PROFICIENCY IN ELECTRONIC AND MECHANICAL BLUEPRINT READING.

01.01 Describe types of blueprints & their applications. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	01.02 Read drawings & transfer measurements. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	01.03 Identify, use & understand application of auxiliary views, revolutions, sectional views & orthographic projections. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
01.04 Apply dimensioning practices & techniques to drawings. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	01.05 Apply x-y coordinate dimensioning. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	01.06 Apply geometric dimensioning & tolerancing procedures. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
01.07 Identify symbols used to represent materials & standard fits. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	01.08 Interpret mechanical production blueprints & assembly drawings. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	01.09 Trace a circuit through a multilayer board. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

02.0 DEMONSTRATE PROFICIENCY IN ELECTRONIC COMMUNICATIONS CIRCUIT.

02.01 Construct & analyze Amplitude Modulated (AM) circuits. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	02.02 Construct & analyze Frequency Modulated (FM) circuits. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	02.03 Define radio propagation, antennas & transmission lines. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

03.0 DEMONSTRATE PROFICIENCY IN ADVANCED MICROPROCESSORS.

03.01 Identify the characteristics & functions of advanced microprocessor chips. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	03.02 Analyze programs for advanced microprocessors using machine languages. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	03.03 Identify diagnostic troubleshooting equipment on advanced microprocessor systems. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
03.04 Describe the operation & applications of synchronous & asynchronous devices, interface adapters & timer modules. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	03.05 Analyze the basic architecture of a typical microcomputer system, & describe the types of input & output storage methods used. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	03.06 Analyze & program MPU's (Micro Processing Unit) using subroutines & interrupts. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
03.07 Interface advanced peripheral devices. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	03.08 Describe the operation of data communications systems. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	03.09 Identify the components of data communications systems. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
03.10 Describe & define data communication codes, formats & protocols. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	03.11 Identify serial & parallel ports & explain their use. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	03.12 Set up & operate modems. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
03.13 Analyze & troubleshoot basic modems. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	03.14 Identify & describe types of carrier systems. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	03.15 Interconnect systems using the RS-232, RS-422 & IEEE488 interface standards. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
03.16 Identify & define base band & broad band local area networks. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

04.0 DEMONSTRATE PROFICIENCY IN COMPUTER SOFTWARE APPLICATIONS.

04.01 Identify the major types of industrial software languages currently in use. 1 2 3 K Verification	04.02 Load & run various types of software programs in a micro computer. 1 2 3 K Verification	04.03 Utilize diagnostic software to troubleshoot malfunctions. 1 2 3 K Verification
04.04 Identify & utilize various software packages. 1 2 3 K Verification	04.05 Execute applicable software packages. 1 2 3 K Verification	1 2 3 K Verification
1 2 3 K Verification	1 2 3 K Verification	1 2 3 K Verification

05.0 DEMONSTRATE PROFICIENCY IN MOTORS AND MOTOR CONTROL CIRCUITS.

05.01 Identify & locate reference documents for the National Electric Code & other electrical standards. 1 2 3 K Verification	05.02 Identify types of relays & describe their operation & applications. 1 2 3 K Verification	05.03 Identify types of electric motors & describe their operation & applications of protection circuits. 1 2 3 K Verification
05.04 Identify types of transformers & describe their operation & applications. 1 2 3 K Verification	05.05 Identify types of motor controllers & describe their operation & applications. 1 2 3 K Verification	05.06 Interpret relay ladder logic diagrams. 1 2 3 K Verification
05.07 Construct manual motor starting & reversing circuits. 1 2 3 K Verification	05.08 Construct magnetic motor starting & reversing circuits. 1 2 3 K Verification	05.09 Construct & troubleshoot relay logic circuits. 1 2 3 K Verification

05.10 Identify the basic elements of solid state motor control. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	05.11 Analyze & construct basic transformer configurations. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	05.12 Analyze & troubleshoot variable frequency drives & synchronous systems. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
05.13 Analyze & troubleshoot brushless DC motor controls. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	05.14 Construct & troubleshoot timing control circuits. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	05.15 Identify power distribution systems. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
05.16 Analyze & construct photoelectric & proximity sensor circuits. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	05.17 Identify, analyze & program programmable logic controllers (PLC). 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

06.0 DEMONSTRATE PROFICIENCY IN LASER ELECTRO-OPTICS.

06.01 Identify safety hazards & regulations of laser applications. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	06.02 Define, calculate & measure the properties of laser light. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	06.03 Define the elements of a basic lasing system. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
06.04 Identify & define types & classes of lasers. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	06.05 Define the fundamental laws of optics. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	06.06 Identify & define the function of laser accessories. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
06.07 Analyze & define common laser applications. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	06.08 Analyze & measure laser outputs. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	06.09 Align & adjust laser systems for specific outputs. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification

06.10 Define the use of electro-optic modulators & mechanical beam deflectors.
1 ☐ 2 ☐ 3 ☐ K ☐
Verification

06.11 Measure the characteristics of electro-optic emitters & detectors.
1 ☐ 2 ☐ 3 ☐ K ☐
Verification

06.12 Identify electro-optic principles.
1 ☐ 2 ☐ 3 ☐ K ☐
Verification

06.13 Construct circuits for electro-optic light sources.
1 ☐ 2 ☐ 3 ☐ K ☐
Verification

06.14 Construct & troubleshoot electro-optic display circuits.
1 ☐ 2 ☐ 3 ☐ K ☐
Verification

06.15 Construct circuits for light reactive devices.
1 ☐ 2 ☐ 3 ☐ K ☐
Verification

06.16 Measure light transmission through fiber optic devices.
1 ☐ 2 ☐ 3 ☐ K ☐
Verification

1 ☐ 2 ☐ 3 ☐ K ☐
Verification

1 ☐ 2 ☐ 3 ☐ K ☐
Verification

1 ☐ 2 ☐ 3 ☐ K ☐
Verification

1 ☐ 2 ☐ 3 ☐ K ☐
Verification

1 ☐ 2 ☐ 3 ☐ K ☐
Verification

07.0 DEMONSTRATE PROFICIENCY IN HYDRAULIC AND PNEUMATIC SYSTEMS.

07.01 Identify the components of hydraulic systems & describe their functions.
1 ☐ 2 ☐ 3 ☐ K ☐
Verification

07.02 Construct & troubleshoot basic hydraulic circuits.
1 ☐ 2 ☐ 3 ☐ K ☐
Verification

07.03 Identify hydraulic symbols, components & types of fluids.
1 ☐ 2 ☐ 3 ☐ K ☐
Verification

07.04 Construct & troubleshoot hydraulic circuits using flow control valves, pressure valves & sequence valves.
1 ☐ 2 ☐ 3 ☐ K ☐
Verification

07.05 Construct & troubleshoot hydraulic circuits using directional & slow control valves.
1 ☐ 2 ☐ 3 ☐ K ☐
Verification

07.06 Analyze, construct & troubleshoot hydraulic circuits that utilize actuator speed control & counter balance devices.
1 ☐ 2 ☐ 3 ☐ K ☐
Verification

07.07 Construct & troubleshoot hydraulic circuits using reducing & unloading valves.
1 ☐ 2 ☐ 3 ☐ K ☐
Verification

07.08 Construct & troubleshoot hydraulic circuits using accumulators.
1 ☐ 2 ☐ 3 ☐ K ☐
Verification

07.09 Construct & troubleshoot a regenerative hydraulic circuit & a hydraulic circuit using remote control.
1 ☐ 2 ☐ 3 ☐ K ☐
Verification

07.10 Construct & troubleshoot hydraulic circuits for deceleration & braking. 1 2 3 K Verification	07.11 Identify the components of pneumatic systems & describe their functions. 1 2 3 K Verification	07.12 Troubleshoot & repair pneumatic valves, compressors, pumps & regulators. 1 2 3 K Verification
07.13 Analyze & define gas pressure storage & force in basic pneumatic circuits. 1 2 3 K Verification	07.14 Construct & troubleshoot pneumatic circuits & systems. 1 2 3 K Verification	1 2 3 K Verification
1 2 3 K Verification	1 2 3 K Verification	1 2 3 K Verification

08.0 DEMONSTRATE PROFICIENCY IN MECHANICAL POWER TRANSMISSION SYSTEMS.

08.01 Utilize precision measuring instruments. 1 2 3 K Verification	08.02 Construct & align mechanisms to demonstrate displacement, velocity & torque ratios. 1 2 3 K Verification	08.03 Identify, analyze & repair compound & reverted gear trains. 1 2 3 K Verification
08.04 Identify, analyze & repair internal & planetary gear trains. 1 2 3 K Verification	08.05 Identify, analyze & repair helical & bevel gear trains. 1 2 3 K Verification	08.06 Identify, analyze & repair rack & pinion, worm & wheel & block & screw mechanisms. 1 2 3 K Verification
08.07 Identify, analyze & repair counter rotating mechanisms & differentials. 1 2 3 K Verification	08.08 Identify, analyze & repair spring mechanisms, pulley blocks & differential hoists. 1 2 3 K Verification	08.09 Identify, analyze & repair chain, belt & disc drives & universal joints. 1 2 3 K Verification
08.10 Identify, analyze & repair clutch & coupling mechanisms. 1 2 3 K Verification	08.11 Identify, analyze & repair bearings, bushings & cams. 1 2 3 K Verification	08.12 Apply proper lubrication to mechanical system components. 1 2 3 K Verification

1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

09.0 DEMONSTRATE PROFICIENCY IN MECHANISMS, LINKAGES AND LEVERS.

09.01 Identify, analyze & repair clutch & brake mechanisms. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	09.02 Identify, analyze & repair class one, two, three & compound levers. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	09.03 Identify, analyze & repair rocker arm & bell crank linkages & combined mechanisms. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
09.04 Identify, analyze & repair four-bar mechanisms (crank, rocker & double rocker). 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	09.05 Identify, analyze & repair drag link & intermediate mechanisms. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	09.06 Identify, analyze & repair four-bar variations. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
09.07 Identify, analyze & repair cam mechanisms. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	09.08 Identify, analyze & repair pivoted follower mechanisms. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	09.09 Identify, analyze & repair toggle, quick return & ratchet mechanisms. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
09.10 Identify, analyze & repair harmonic drives. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	09.11 Identify, analyze & repair geneva mechanisms. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

10.0 DEMONSTRATE PROFICIENCY IN TRANSDUCERS AND INSTRUMENTATION.

10.01 Measure fluid flow & liquid levels with transducer circuits. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	10.02 Utilize operational amplifier circuits for transducer applications. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	10.03 Construct & utilize circuits for thermal sensing devices. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
10.04 Set up & test strain gage circuits. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	10.05 Utilize pressure transducers to monitor hydraulic & pneumatic circuits. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	10.06 Utilize acceleration transducers. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
10.07 Utilize positional transducers. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	10.08 Construct & troubleshoot circuits for sound transducers. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	10.09 Set up & operate transducer recording devices. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

11.0 DEMONSTRATE PROFICIENCY IN VIDEO SYSTEMS.

11.01 Define the principles of video signal generation & video graphics. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	11.02 Analyze & troubleshoot monitor power supplies. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	11.03 Analyze & troubleshoot sweep circuits. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
11.04 Analyze & troubleshoot high voltage circuits. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	11.05 Analyze & troubleshoot video circuits. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	11.06 Analyze & troubleshoot sync circuits. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification

11.07 Align color monitors for proper operation. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	11.08 Analyze & troubleshoot video monitor sound circuits. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	11.09 Analyze & troubleshoot color circuits. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
11.10 Interconnect video system components using coaxial cables. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

12.0 DEMONSTRATE PROFICIENCY IN STATICS AND INDUSTRIAL MATERIALS.

12.01 Define & measure forces & loads in structures using a ring force transducer. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	12.02 Define & analyze force systems acting on beams. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	12.03 Define & measure the mechanical properties, tensile strength, modules of elasticity & hardness of materials. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
12.04 Define & measure the effects of heat treating & aging on the properties of materials (Rockwell, Brinell, tensile testing). 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	12.05 Identify the effects of corrosion & electroplating on materials. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	12.06 Define the properties of plastic materials. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

13.0 DEMONSTRATE PROFICIENCY IN AUTOMATIC CONTROLS AND ROBOTICS.

13.01 Utilize complex motor control circuits including variable frequency drives. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	13.02 Analyze & interpret complex ladder diagrams. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	13.03 Analyze the operation of programmable controllers in robotic systems. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
13.04 Develop programs for programmable controllers in an automated work cell. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	13.05 Specify & utilize various sensor devices. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	13.06 Analyze the operation of robotic work cells & support equipment. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
13.07 Analyze & troubleshoot specific robot systems. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	13.08 Analyze & implement robotic software programs, & explain pendant operations. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	13.09 Interface robot systems with other automatic equipment. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
13.10 Troubleshoot & repair automation control systems. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	13.11 Identify & analyze various robotic motor systems. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

0.0 DEMONSTRATE EMPLOYABILITY SKILLS.

0.01 Conduct a job search. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	0.02 Secure information about a job. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	0.03 Identify documents that may be required when applying for a job. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
0.04 Complete a job application form correctly. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	0.05 Demonstrate competence in job interview techniques. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	0.06 Identify or demonstrate appropriate responses to criticism from employer, supervisor or other persons. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
0.07 Identify acceptable work habits. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	0.08 Demonstrate knowledge of how to make job changes appropriately. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	0.09 Demonstrate acceptable employee health habits. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification

00.0 DEMONSTRATE AN UNDERSTANDING OF ENTREPRENEURSHIP.

00.01 Define entrepreneurship. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	00.02 Describe the importance of entrepreneurship to the American economy. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	00.03 List the advantages & disadvantages of business ownership. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
00.04 Identify the risks involved in ownership of a business. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	00.05 Identify the necessary personal characteristics of a successful entrepreneur. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification	00.06 Identify the business skills needed to operate a small business efficiently & effectively. 1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

000.0 COOPERATIVE WORK EXPERIENCE COMPETENCIES.

1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification
1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification	1 ☐ 2 ☐ 3 ☐ K ☐ Verification

VERIFICATION

The instructor should verify the level of mastery achieved by the student by initialing the competency box each time the student masters a competency. Later, if the student achieves a higher degree of mastery of a competency, the higher degree should be recorded and verified by the instructor.

INSTRUCTOR SHOULD SIGN FULL NAME AND SCHOOL NAME AND ADDRESS IN THE SPACE BELOW.

_____ Verification	_____ Signature _____ Title _____ School Name _____ School Address _____
_____ Verification	_____ Signature _____ Title _____ School Name _____ School Address _____
_____ Verification	_____ Signature _____ Title _____ School Name _____ School Address _____

COOPERATIVE WORK EXPERIENCE

In addition to classroom training and laboratory performance identified on the Career MAP, this student has participated in cooperative work experience with employers as shown below:

Dates _____ Employer _____

Address of Employer _____

Supervisor _____

Supervisor Title _____

Dates _____ Employer _____

Address of Employer _____

Supervisor _____

Supervisor Title _____

Dates _____ Employer _____

Address of Employer _____

Supervisor _____

Supervisor Title _____

NOTES

This section of the MAP is provided so the instructor, employer, or student may list additional qualifying statements or other pertinent information. All comments should be initialed for verification.